REMARKS

The amendments to the specification correct minor errors. No new matter is believed to be added to the application by this Amendment.

Status of the Claims

Claims 1, 2 and 5-15 are pending in the application. Claims 12 and 13 have been withdrawn from consideration by the Examiner. The amendments to claims 1 and 2 incorporate the subject matter of canceled claims 3 and 4. Claims 5, 6, 8 and 9 have been amended so as not to be dependent upon a canceled claim. The amendments to claim 11 improve the language of that claim. Support for claims 14 and 15 can be found at page 7 of the specification.

Interview with the Examiners

Applicants thank the Examiners for graciously conducting an Interview with the Applicants representative on January 15, 2003. The Interview Summary has been reviewed and it appears to accurately reflect the substance of the Interview, wherein agreement was reached that the proposed amended claims would overcome the prior art rejections.

Rejections Under 35 U.S.C. 112, Second Paragraph (Paragraph 2 of the Office Action)

Claim 11 is rejected under 35 U.S.C. 112, second paragraph as being indefinite. Applicants traverse.

Claim 11, as amended, clearly sets forth the subject matter being claimed. As a result, claim 11 is clear, definite, and has full antecedent basis. Accordingly, this rejection is overcome and withdrawal thereof is respectfully requested.

Rejections Based Upon Mishima (Paragraphs 3-5 of the Office Action)

Claims 1-3, 6 and 7 are rejected under 35 U.S.C. 103(a) as being obvious over Mishima (U.S. Patent No. 5,633,516) in view of Inoue (U.S. Patent No. 5,134,446) and Kizuki (U.S. Patent No. 5,948,161). The Examiner adds the teachings of Schmitz (U.S. Patent No. 6,316,820) to reject claims 4, 5 and 8-10. Applicants traverse.

The Present Invention and Its Advantages

The present invention pertains to a 3-5 group compound semiconductor that includes a GaAs substrate, a buffer layer over the GaAs substrate and an epitaxial crystal layer over the buffer layer. The buffer layer has a multi-layered structure formed by laminating at least two kinds of layers having different compositions for $1 \leqq n \leqq 30$ times wherein n is the number of

repetitions of the two types of layers. Of the two types of layers, one type of layer is a GaAs layer and the other type of layer is a $Ga_{1-z}Al_zAs$ layer where $0<z\leqq1$. An important aspect of the invention is that the multilayers comprising the buffer layer do not contain indium as a component.

Distinctions of the Invention Over the Cited Art

Mishima pertains to a lattice-mismatched crystal structure that includes a semiconductor film formed on a substrate with an intervening buffer layer. Figure 1 of Mishima shows a GaAs substrate 1 over which is found a buffer layer 2, an undoped InGaAs channel forming layer 3, an InAlAs spacer layer 4, a carrier supply layer 5, an undoped InAlAs layer 6 and a cap layer 7. Mishima fails to disclose or suggest a buffer layer having multiple layers that are not formed by varying indium content.

Although Mishima discloses a multi-layered buffer layer, Mishima forms the buffer layer by varying the indium content. Mishima at column 3, lines 48-54 states "The InAlAs layer 2 comprises a plurality of layers formed by varying the ratio of thickness in each step of In composition in a first region where the In composition continuously varies, by varying the thickness of the buffer layer itself, and by varying the number of steps of In composition of the buffer layer."

In contrast, the present invention has a multilayer buffer formed from alternating layers of GaAs and $Ga_{1-z}Al_zAs$, and no variation of indium is required to form the two types of layers. As a result, a person having ordinary skill in the art would not be motivated to use the teachings of Mishima to form the multilayer of the invention. The additional cited art of Inoue, Kizuki and Schmitz fail to address the deficiencies of Mishima. Thus, a *prima facie* case of obviousness has not been made over Mishima and the secondary references.

Accordingly, this rejection is overcome and withdrawal thereof is respectfully requested.

Information Disclosure Statement

Applicants thank the Examiner for considering the Information Disclosure Statement filed March 25, 2002 and for making the initialed PTO-1449 form of record in the application in the Office Action mailed July 18, 2002.

Conclusion

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Robert E. Goozner, Ph.D. (Reg. No. 42,593) at the telephone number of the undersigned below, to conduct an

interview in an effort to expedite prosecution in connection with the present application.

Attached hereto is a marked-up version of the changes made to the application by this Amendment.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully petition(s) for a three (3) month extension of time for filing a reply in connection with the present application, and the required fee of $930.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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ADM/REG:jls
2185-0578P

Attachment: Version with Markings to Show Changes Made

(Rev. 02/20/02)

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning on page 1, line 7, has been amended as follows:

--Compound semiconductors of this kind have a laminated structure of epitaxial crystal layers of 3-5 group compound semiconductor on a GaAs substrate, and for example, light emitting elements, which [is] are widely used, have a laminated structure consisting of an $Al_{0.20}Ga_{0.80}As$ acting as a light emitting layer (active layer) and an $Al_{0.5}Ga_{0.5}As$ layer acting as a barrier layer (clad layer) on a GaAs substrate, to give red light emission. Optical devices of this kind have a characteristic that the overflow of injected electrons and [halls] holes is suppressed by a large potential barrier owing to band gap discontinuity obtained by the hetero junction[,]. [consequently,] Consequently, high light emitting efficiency can be attained. Though optical devices are exemplified for illustrations in the above, in addition to them, electronic devices such as HBT(hetero junction bipolar transistors) and HEMT(high electron mobile transistors) [have also] also have a laminated structure of epitaxial crystal layers of 3-5 group compound semiconductor on a GaAs substrate.--

The paragraph beginning on page 2, line 17, has been amended as follows:

--Therefore, various methods for lowering dislocation density of GaAs [substrate] substrates have been conventionally tried, such as a method of decreasing heat stress, namely, temperature gradient, in the production of a GaAs substrate, a method of increasing critical shearing stress, and the like.--

The paragraph beginning on page 5, line 13, has been amended as follows:

--Fig. 1 is a sectional view showing one embodiment of an optical device according to the invention. The thin film crystal wafer 1 is used for producing a semiconductor light emitting element, and formed by sequentially growing a plurality of epitaxial crystal layers on a semi-insulating GaAs substrate 2 using an [Organic] organic metal vapor phase epitaxy (hereafter, referred to as OMVPE) method.--

IN THE CLAIMS:

Claims 3 and 4 have been canceled.

The claims have been amended as follows:

1.(Amended) A 3-5 group compound semiconductor comprising a GaAs substrate, a buffer layer on said GaAs substrate and an epitaxial crystal layer on said buffer layer, said layers being formed by an epitaxial crystal growth method, wherein

said buffer layer [and said epitaxial crystal layer on said buffer layer are 3-5 group compound semiconductors each

independently represented by the general formula $In_xGa_yAl_zAs$ (wherein, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $x+y+z=1$),] has a structure formed by laminating at least two kinds of layers having different compositions for n ($1 \leq n \leq 30$) times, where n is the number of repetitions of the two kinds of layers, and the two kinds of layers are a $Ga_{1-z}Al_zAs$ layer (wherein $0<Z \leq 1$) and a GaAs layer, and the dislocation density in the epitaxial crystal layer on said buffer layer is $2000/cm^2$ or less.

2.(Amended) A 3-5 group compound semiconductor comprising a GaAs substrate, a buffer layer on said GaAs substrate and an epitaxial crystal layer on said buffer layer, said layers being formed by an epitaxial crystal growth method, wherein

said buffer layer [and said epitaxial crystal layer on said buffer layer are 3-5 group compound semiconductors each independently represented by the general formula $In_xGa_yAl_zAs$ (wherein, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $x+y+z=1$),] has a structure formed by laminating at least two kinds of layers having different compositions for n ($1 \leq n \leq 30$) times, where n is the number of repetitions of the two kinds of layers, and the two kinds of layers are a $Ga_{1-z}Al_zAs$ layer (wherein $0<Z \leq 1$) and a GaAs layer, and the dislocation density in said epitaxial crystal layer on the buffer layer is 1/3 or less of the dislocation density in said GaAs substrate.

5.(Amended) The 3-5 group compound semiconductor according to [Claim 4] claim 1 or 2, wherein the value of said z is 0.01 or more and 0.4 or less.

6.(Amended) The 3-5 group compound semiconductor according to [Claim 3] claim 1 or 2, wherein at least one layer of said two kinds of layers is doped with an n-type dopant.

8.(Amended) The 3-5 group compound semiconductor according to [Claim 3] claim 1 or 2, wherein an n-type dopant is planar-doped in at least one layer of said two kinds of layers.

9.(Amended) The 3-5 group compound semiconductor according to [Claim 3] claim 1 or 2, wherein an n-type dopant is planar-doped on the interface of at least one layer of said two kinds of layers.

11.(Twice Amended) A light-emitting element [obtained by using] comprising the 3-5 group compound semiconductor of claim 1.

Claims 14 and 15 have been added.